Modern Concepts of Cardiovascular Disease

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ROENTGEN RAY INTERPRETATION OF CARDIOVASCULAR DISEASE

Part II

If the left ventricle is predominantly affected, the "waist" of the heart, as seen in the anterior view, becomes somewhat deepened and the mass of the heart develops downward, to the left and backward; this is called aortic configuration, especially so if the course of the aorta shows an increased curvature at the same time. Lesions which may produce this shape are aortic valvular lesions, long-standing hypertension and sometimes left ventricular hypertrophy and dilatation following coronary disease. A similar configuration, however, is seen in the presence of a high position of the diaphragm or if the aorta is elongated or diseased.

If the right ventricle is predominantly affected, the left heart contour as seen in the anterior view, will be straight or even convexly prominent; the mass of the heart develops mainly forward and upward to the left. This is called a "mitral configuration", especially if the course of the aorta is poorly visible. The lesion which may produce this shape most commonly is mitral stenosis and regurgitation. A similar configuration, however, is seen physiologically in young women in the presence of a low diaphragm, in pneumoconiosis and emphysema, in thyrotoxicosis, in right convex scoliosis of the spine leading to rotation of the heart and sometimes in adhesive pericarditis.

The enlargement of the left auricle may be seen even in the anterior view as a denser central area within the heart shadow or developing from without the mediastinum into the right lung field. The method of choice is to examine the patient in the right anterior oblique position; here the posterior mediastinum appears to be encroached upon. Definite enlargement speaks in favor of mitral valvular lesion, while the absence of enlargement is rather against it. The posterior outline of the left atrium can be well visualized in demonstrating the course of the barium filled esophagus. In any considerable degree of left atrium enlargement, the esophagus appears displaced and narrowed down in one plane. Especially in cases of fibrillation and rapid heart action, mitral stenosis is sometimes difficult to diagnose and here the roentgenological examination is of definite aid. It may also serve to explain certain clinical symptoms which may be brought about by a high degree of left auricular enlargement. These are left sided bronchostenosis and atelectasis of lung tissue; pleural pain and dulness by percussion in the right lower interscapular space; minor degrees of difficulty in swallowing and hoarseness. The latter symptom may be caused by pressure of the pulmonary artery, which is found to be displaced and enlarged in certain cases of mitral valvular lesion. In the presence of enlargement of the ventricular mass, especially of the left ventricle, the posterior mediastinum also is decreased in its depth.

Here it may be remarked that in certain people of the hypoplastic-asthenic type, any considerable degree of cardiac hypertrophy and dilatation as a whole or of one or two chambers may not develop. Thus we are not enabled to see the changes in the size and shape which would be "predicted" as sequelae of the underlying pathology.

An enlargement of the cardiac silhouette is of course noted in pericardial effusion of an appreciable degree; due to the expansion of the cephalic portion of the pericardial cavity, a corresponding shortening of the great vessel shadow takes place especially in the recumbent position. The degree of this change depends upon anatomical variations of the reflection line of the pericardium. A special form of the cardiac silhouette, called coeur en sabot (the silhouette has some resemblance to that of a wooden shoe as worn by the Dutch peasant woman), is found in congenital malformations with right ventricular hypertrophy but little dilatation, as in the rather common type called Fallot's tetralogy. This consists of pulmonary stenosis, dextroposition of the aortic orifice, interventricular septal defect and right ventricular hypertrophy. A pear-shaped silhouette, sometimes slightly irregularly outlined, may be found in adhesive, constrictive pericardial disease. Very little if any enlargement may be expected unless other factors are acting like rheumatic valvular disease. Aneurysm of the heart is rarely diagnosed, partly because no visible bulge occurs though the wall may be thinned out and partly because the aneurysm is usually located around the apical portion where the heart shadow fuses with the liver shadow. Additional localized pericardial adhesions may further blur

this area.

In evaluating the size of the aorta, it is safe to say that the roentgenological diagnosis of enlargement is more often made, though not present, than it is missed when it actually does exist. No reliable way of measuring the size of the ascending aorta exists. However, the size of the arch of the aorta can be determined. The size of the aorta is usually overestimated in the stout constitutional type, in the presence of tortuosity of the aorta, in scoliosis to the left side and if the descending aorta is located to the left side of the spine, as it occurs as an anatomic variation. The size of the aorta increases continuously with age; while the average circumference above the valves is 5.9 and 5.5 cm. for male and female respectively in the age group 23-30 years, it is 8.2 and 7.7 cm. in the age group 71-80 years. One may therefore normally expect in older people a relatively large aorta as seen by X-ray. People with a high body weight may be expected to have a larger aorta too. A diffuse enlargement of the aorta, often affecting predominantly the ascending aorta, when seen in children indicates a malformation (i. e., wide aorta, small pulmonary artery; coarctation of the aorta; or rarely rheumatic aortitis). An enlargement observed in a middle-aged person is especially found in the anatomically progressive form of luetic aortitis. It is also seen in the presence of rheumatic aortic valvular lesions and rarely in hypertension. Coarctation of the aorta also needs to be remembered. In older people a simple dilatation or arteriosclerotic dilatation should be considered. The very first part of the aorta, just above the valves and intrapericardial in location cannot be differentially roentgen rayed. Here dilatation, even aneurysmal in size is not available for the X-ray examination. Very small aneurysms at the arch may also be invisible. Otherwise any type and any location of aneurysmal dilatation is readily detected. An abnormal narrowness of the aorta is to be seen in congenital malformations. A very small vessel shadow together with a large globular heart is rather characteristic of transposition of the large vessels.

The pulmonary arch which is seen in the roentgen ray picture between the aortic arch above and the left ventricular mass below is caused by the pulmonary artery and often also by the pulmonary conus which is the upper portion of the right ventricle. An enlargement and prominence of the pulmonary artery in the roentgen ray picture is seen in a number of conditions, some of which may be enumerated here.

1. Infections and inflammatory changes of syphilitic, rheumatic and mycotic origin.

2. Primary degenerative processes in the pulmonary arterial system in the lungs; sometimes with additional inflammatory and thrombotic processes. In this connection the primary arteriosclerosis and the secondary atherosclerosis may be mentioned. The latter is found in the presence of mitral valvular lesions and in lung disease, such as emphysema, bronchiectasis, extensive fibrosis and pleural adhesions.

3. Congenital anomalies; enlargement always occurs in the presence of a large defect of the interatrial septum, often in the presence of a patent ductus arteriosus, and occasionally in the presence of an interventricular septal defect.

4. Retraction by a shrinking process at the left side of mediastinum and lung.

5. Rupture of an aortic aneurysm into the pulmonary artery, following trauma.

6. In acquired valvular lesion of the pulmonary orifice.

7. In the presence of thyrotoxicosis.

The study of the size, shape and action of the heart itself as well as of the intrapulmonary branches of the pulmonary artery gives some points for differential diagnosis.

Besides the constitutional variations in the position of the heart, a shift towards the right side of the chest may be caused either by extrinsic conditions such as congenital absence of the muscle of the left leaf of the diaphragm (also called "eventration"), left sided pneumothorax, exudate, cystic lung or diminution of the right lung volume, as might occur for instance in extensive fibrosis of the lung. Dextrocardia as an insolated congenital malformation and finally dextrocardia as a part of a complete transposition of the viscera may also cause the heart to be abnormally placed. These various possibilities can easily be distinguished by roentgen ray examination. The aortic arch may also have an abnormal position, turning to the right instead of to the left. This congenital anomaly may give no symptoms whatever. Occasionally, however, it produces signs and symptoms of partial obstruction of the esophagus or of the trachea.

Normally we notice that during deep inspiration the heart lowers its position, together with the diaphragm. This is more pronounced in the diaphragmatic type of respiration, and but little pronounced if the costal type of respiration is present. A definite rise of the heart shadow observed during inspiration, especially when the lower heart and the diaphragmatic contour tend partly to separate from each other, is an important sign of fixation of the heart to the anterior chest wall. If the patient is studied when lying down on the right and left side respectively and with a horizontal course of the roentgen ray, one will normally see that during inspiration the heart shadow (mediastinum) will move toward the non-supported side of the body; if this inspiratory shift does not take place then mediastinal fixation of the heart is most likely to be present. If during examination in the upright position the mediastinum elicits a marked respiratory shift to one side, bronchial obstruction of different etiology, like aneurysm, bronchial carcinoma or non-opaque foreign body should be considered.

(*To be continued*)

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